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| 10/699,658 | 11/04/2003 | Yung-Jun Park | 1349.1299 | 6464 |

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| EXAMINER | |
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| TORRES, JOSE | |
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/699,658 | PARK ET AL. | |
| | Examiner | Art Unit | |
| | Jose M. Torres | 2624 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *08 May 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *18* is/are allowed.

6)☒ Claim(s) *1-5,7-11,13-17,19 and 20* is/are rejected.

7)☒ Claim(s) *6, 12 and 21* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Comments*

1. The Amendment filed on May 8, 2007 has been entered and made of record.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1, 2, 8, 14 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuji et al. (US 5,294,986) in view of Quardt et al. (US 5,434,931).

As to claim 1, Tsuji et al. teaches a contrast compensation apparatus (Col. 1 lines 7-10), comprising: a pixel value detection unit (FIG. 1, "histogram memory **8**") to detect a distribution of pixel values of respective pixels of an input image signal (Col. 5 lines 6-13); and a mapping unit (FIG. 1, "histogram accumulating circuit **9**, cumulative histogram memory **10**, look-up table operating circuit **11**, and look-up-table memory **12**"), coupled to the pixel value limit unit, to set a luminance of the respective pixels based on a cumulative distribution function with respect to the re-configured pixel values (Col. 5 line 14 through Col. 6 line 4).

However, Tsuji et al. does not explicitly disclose a pixel value limit unit having pre-set luminance limit values and being coupled to the pixel value detection unit, re-

configuring the distribution of the pixel values of the respective pixels based on the pre-set luminance limit values.

Quardt et al. teaches a pixel value limit unit (FIG. 5, "processor **210**") having pre-set luminance limit values ("lower range of elements and upper range of elements") and being coupled to the pixel value detection unit, re-configuring the distribution of the pixel values of the respective pixels based on the pre-set luminance limit values (Col. 5 line 45 through Col. 6 line 68 and Col. 10 lines 7-25).

Therefore, in view of Quardt et al., it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Tsuji et al.'s apparatus by incorporating the processor, as taught by Quardt et al., between the pixel value detecting unit and the mapping unit in order to transform the image element levels to produce an image having increased contrast (Col. 8 line 67 through Col. 9 line 23).

As to claim 2, Tsuji et al. does not explicitly disclose a first setting value to set an upper limit of the detected pixel values of the respective pixels; and a second setting value to set a lower limit of the detected pixel values of the respective pixels.

Quardt et al. further teaches a first setting value to set an upper limit of the detected pixel values of the respective pixels; and a second setting value to set a lower limit of the detected pixel values of the respective pixels (The range reduction routine executed by the processor of Figure 5 sets a lower and upper range in which the sum of the original element counts in each range equals a predetermined percentage. These

elements are then remapped over the entire reduced range to provide an image with greater contrast. Col. 5 lines 45-64).

As to claim 8, the contrast compensation method as claimed corresponds to that of the contrast compensation apparatus of claim 1. The only difference is the contrast setting against the luminance setting of claim 1, which has been already addressed above. Therefore, the arguments are the same as those previously presented above.

As to claim 14, the modifications made to the apparatus of Tsuji et al. by Quardt et al. can be readily implemented in a computer-readable medium such as that described in Col. 10 lines 7-26 of Quardt et al. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make such modifications for the same reasons as those stated in claim 1 above.

As to claim 19, Tsuji et al. teaches a contrast compensation apparatus, comprising: a probability density function (PDF) calculation unit, to detect a pixel value of respective pixels of an input image (FIG. 1, "histogram memory **8**", Col. 5 lines 6-13); a cumulative distribution function (CDF) unit, coupled to the BUBO unit, to accumulate the probability functions outputted from the BUBO unit sequentially (FIG. 1, "histogram accumulating circuit **9**, cumulative histogram memory **10**", Col. 5 line 14 through Col. 6 line 4); and a mapping unit, coupled to the CDF compensation unit and to receive the input image, to store reconfigured CDFs and map and output pixel values of the input

image according to the reconfigured CDFs (FIG. 1, "look-up table operating circuit **11**, and look-up-table memory **12**", Col. 5 line 14 through Col. 6 line 4).

However, Tsuji et al. does not explicitly disclose a Bit Under threshold Bit Over threshold (BUBO) unit, coupled to the PDF calculation unit, to set one of a first setting value and a second setting value based on the luminance degree of the respective pixels and output resulting probability functions; and a CDF compensation unit, coupled to the CDF unit, to reconfigure the accumulated probability functions according to a predetermined luminance adjustment that reduces an influence on a total luminance of an output image due to luminance of predetermined portions forming the output image.

Quardt et al. teaches a Bit Under threshold Bit Over threshold (BUBO) unit, coupled to the PDF calculation unit, to set one of a first setting value and a second setting value based on the luminance degree of the respective pixels and output resulting probability functions (FIG. 5, "processor **210**", "lower range of elements and upper range of elements", Col. 5 line 45 through Col. 6 line 68 and Col. 10 lines 7-25); and a CDF compensation unit, coupled to the CDF unit, to reconfigure the accumulated probability functions according to a predetermined luminance adjustment that reduces an influence on a total luminance of an output image due to luminance of predetermined portions forming the output image (The range reduction routine executed by the processor of Figure 5 sets a lower and upper range in which the sum of the original element counts in each range equals a predetermined percentage. These elements are then remapped over the entire reduced range to provide an image with greater contrast. Col. 5 lines 45-64).

Therefore, in view of Quardt et al., it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Tsuji et al. by incorporating the processor and the range reduction routine, as taught by Quardt et al., in which a first and a second setting value based on the luminance degree are set, and the compensation unit to reconfigure the probability functions according to the luminance adjustments in order to transform the image element levels to produce an image having increased contrast (Col. 8 line 67 through Col. 9 line 23).

4. Claims 3-5, 9, 10, 15, 16 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuji et al. in view of Quardt et al. as applied to claims 2, 8, 14 and 19 above, and further in view of Schu (US 2002/0136464). The teachings of Tsuji et al. modified by Quardt et al. have been discussed above.

As to claims 3-5, Tsuji et al. modified by Quardt et al. fails to teach a first comparison part to compare the pixel values of the respective pixels detected from the pixel value detection unit with the first setting value, and to output the first setting value when the detected pixel values exceed the first setting value; and a second comparison part to compare the pixel values of the respective pixels detected from the pixel value detection unit with the second setting value, and to output the second setting value when the detected pixel values of the respective pixels are smaller than the second setting value; a first buffer having an input terminal from which an image signal is inputted, and an output terminal connected to an output terminal of the first comparison part; a first storage to store a first setting value; and a first comparator to compare the

image signal with the first setting value of the first storage, and, based on a result of the comparison, enable one of: the first buffer so that the detected pixel value is outputted to the second comparison part; and the first storage so that the first setting value is outputted to the second comparison part; a second buffer having an input terminal to receive output from the first comparison part, and an output terminal connected to an output terminal of the second comparison part; a second storage to store a second setting value; and a second comparator to compare the output from the first comparison part with the second setting value of the second storage, and, based on a result of the comparison, to enable one of: the second buffer so that the output value of the first comparison part is outputted from the pixel value limit unit; and the second storage so that the second setting value is outputted from the pixel value limit unit.

Schu teaches a method and a circuit for automatically enhancing the contrast of an image, wherein two transformation functions are produced and the transformed pixel values produced by applying these functions are limited to an upper limit value YHIGH and a lower limit value YLOW. Therefore, similar to the claimed invention of claims 3-5, the circuit arrangement and the method as taught by Schu teaches the processing of an image to enhance its contrast by applying a mapping function ("$Y=f(X)=f_L(x_k)Uf_U(x_k)$") wherein the processed pixel values are limited to a range [YLOW, YHIGH]. Even though the first and second comparison parts with their respective buffers, storages, and comparators are not explicitly disclosed in Schu as claimed in the present invention, the functionality of the Mapper **4** and the transformation functions calculation units **2** and **3** of FIG. 1 processes the image in the same way not letting any processed pixel be

larger than the upper limit YHIGH or lower than the lower limit YLOW, and when the input pixel is larger or lower than the upper or lower limit values, respectively the output value is that of the lower and/or upper limit (Paragraphs [0032]-[0037]).

Therefore, in view of Schu, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Tsuji et al. and Quardt et al. by incorporating the mapper and the transformation calculation units, as taught by Schu, to create a range of values, wherein for those pixels being less than the lower limit value YLOW its value gets replaced with YLOW and for those pixels being greater than the upper limit value YHIGH its value gets replaced with YHIGH in order to provide a system that enables the contrast of the image to be enhanced, inter alia, as a function of the contrast already present in the image, it being ensured, however, that the overall impression of the processed output image is at least just as good as that of the original input image (Paragraph [0022]).

As to claims 9 and 15, Quardt et al. teaches setting an upper limit value of the calculated pixel values; and setting a lower limit value of the calculated pixel values (The range reduction routine executed by the processor of Figure 5 sets a lower and upper range in which the sum of the original element counts in each range equals a predetermined percentage. These elements are then remapped over the entire reduced range to provide an image with greater contrast. Col. 5 lines 45-64).

However, Tsuji et al. modified by Quardt et al. fails to teach mapping the calculated pixel values greater than the upper limit value and the calculated pixel values

less than the lower limit value into the upper limit value and the lower limit value, respectively.

Schu teaches a mapping the calculated pixel values greater than the upper limit value and the calculated pixel values less than the lower limit value into the upper limit value and the lower limit value, respectively (As explained above with respect to claims 3-5 the Mapper **4** and the transformation functions calculation units **2** and **3** of FIG. 1 replaces any pixel being lower or greater than the lower and upper limit values YLOW or YHIGH, respectively. Paragraph [0034]).

Therefore, in view of Schu, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Tsuji et al. and Quardt et al. by incorporating the mapper and the transformation calculation units, as taught by Schu, in order to provide a system that enables the contrast of the image to be enhanced, inter alia, as a function of the contrast already present in the image, it being ensured, however, that the overall impression of the processed output image is at least just as good as that of the original input image (Paragraph [0022]).

As to claims 10 and 16, Quardt et al. further teaches converting the cumulative distribution function into a predetermined gray level, and mapping the calculated pixel values of the image signal based on the cumulative distribution function converted to the predetermined gray level (Col. 4 lines 5-21).

As to claim 20, Tsuji et al. modified by Quardt et al. fails to teach a first comparison unit, coupled to the PDF calculation unit, to compare a first setting value with the pixel value detected by the PDF calculation unit, wherein if the pixel value is greater than or equal to the first setting value, the first comparison unit outputs the first setting value; and if the pixel value is less than the first setting value, the first comparison unit outputs the pixel value; and a second comparison unit, coupled to the first comparison unit, to compare a second setting value with the pixel value from the first comparison unit, wherein if the pixel value is less than or equal to the second setting value, the second comparison unit outputs the second setting value; and if the pixel value is greater than the second setting value, the second comparison unit outputs the pixel value to the CDF unit.

As explained above with respect to claims 3-5, Schu teaches the first and second comparison units enabling the pixel values being processed to be the lower or upper limit values if their values are lower/equal than or greater/equal than the limit values or outputting the pixel value if their value is greater than or lower than the lower or upper limit value, respectively (Paragraphs [0032]-[0037]).

Therefore, in view of Schu, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Tsuji et al. and Quardt et al. by incorporating the mapper and the transformation calculation units, as taught by Schu, in order to provide a system that enables the contrast of the image to be enhanced, inter alia, as a function of the contrast already present in the image, it being ensured,

however, that the overall impression of the processed output image is at least just as good as that of the original input image (Paragraph [0022]).

5. Claims 7 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuji et al. in view of Quardt et al. as applied to claims 1 and 8 above, and further in view of Kuo et al. (US 5,982,926). The teachings of Tsuji et al. modified by Quardt et al. have been discussed above.

As to claims 7 and 13, Tsuji et al. modified by Quardt et al. fails to teach the pixel value is one among the brightness value, a grayscale value of three primary colors R, G, B and a grayscale value of color difference signals Y, Cb, Cr.

Kuo et al. teaches the pixel value is one among the brightness value, a grayscale value of three primary colors R, G, B and a grayscale value of color difference signals Y, Cb, Cr (Col. 7 lines 30-43, Col. 8 line 55 through Col. 9 line 7 and lines 55-67).

Therefore, in view of Kuo et al., it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Tsuji et al. and Quardt et al. by incorporating the image processing performed to pixels values that represent a grayscale value of color difference signals Y, Cb, Cr, as taught by Kuo et al., in order to improve the appearance of images as perceived by the human eye, and/or to render these images more suitable for computer analysis (Col. 1 line 65 through Col. 2 line 9.

6. Claims 11 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuji et al. in view of Quardt et al. and Schu as applied to claims 10 and 16 above, and further in view of McCaffrey (US 5,949,918). The teachings of Tsuji et al. modified by Quardt et al. and Schu have been discussed above.

As to claims 11 and 17, Tsuji et al. modified by Quardt et al. and Schu fails to teach dividing the cumulative distribution function by a number of pixels forming the image signal; and multiplying by the predetermined gray level, the cumulative distribution function divided by the number of pixels.

McCaffrey teaches dividing the cumulative distribution function by a number of pixels forming the image signal; and multiplying by the predetermined gray level, the cumulative distribution function divided by the number of pixels (Equation 3 and Col. 4 lines 26-56).

Therefore, in view of McCaffrey, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Tsuji et al., Quardt et al. and Schu by incorporating the mapping function, as taught by McCaffrey, wherein the cumulative distribution function is divided by the number of pixels forming the image and multiplied by the gray level in order to be readably implemented on a typical microprocessor or digital signal processor (DSP) decreasing the processing time (Col. 4 lines 50-56).

***Allowable Subject Matter***

7. Claims 6, 12 and 21 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 18 is allowed.

The following is a statement of reasons for the indication of allowable subject matter: the closest prior art made of record fails to teach or suggest calculating the cumulative distribution function of the calculated pixel values and re-configuring the cumulative distribution function based on a Formula $CDF(K) = CDF(K) - \frac{CDF(N)}{NxK} + K$ where N is a highest pixel value displayable when the image signal forms an image, and K denotes a pixel value, and a pixel value detector, arranged to receive the input image, to detect a pixel value of the input image; a multiplier, coupled to the pixel value detector, to multiply the pixel value detected by a number of pixels used to form a selected image from the input image to provide an image signal; a barrel shifter, coupled to the multiplier, to shift the image signal by a predetermined pixel value used to form the selected image; a subtractor, coupled to the CDF unit and to the barrel shifter, to calculate a difference between an output of the CDF unit and an output of the barrel shifter; and an adder, coupled to the subtractor and to the pixel value detector, to add the pixel value and an output of the subtractor.

## *Response to Arguments*

*Objections to the Specification*

8. Paragraph [0064] has been amended and new paragraph [0065] (Old Paragraph [0064]) has been inserted in order to provide proper antecedent basis for the claim subject matter in claim 14. Therefore, the objection has been removed.

*Claim Objections*

9. Claim 8 line 6 has been amended to recite "setting the contrast" to correct sentence grammar. Therefore, the objection has been removed.

Claim 14 line 8 has been amended to recite "setting the contrast" to correct the claimed limitation. Therefore, the objection has been removed.

*Claim Rejections under 35 U.S.C. § 112*

10. The Specification has been amended in Paragraph [0064] in order to provide proper antecedent basis for the claimed limitation, hence complying with the written description requirement of 35 U.S.C. § 112, first paragraph. Therefore, the rejection has been removed.

*Claim Rejections under 35 U.S.C. § 102*

11. Applicant's arguments, see pages 11-14, filed on May 8, 2007, with respect to the rejection(s) of claim(s) 1-3, 8, 9, 14, 15 and 19 under 35 U.S.C. § 102 have been fully considered and are persuasive. Therefore, the rejection has been withdrawn.

However, upon further consideration, a new ground(s) of rejection is made in view of newly found prior art. See Claim Rejections under 35 U.S.C. § 103 Section above.

*Claim Rejections under 35 U.S.C. § 103*

12. Applicant's arguments, see pages 14-26, filed on May 8, 2007, with respect to the rejection(s) of claim(s) 4, 5, 7, 10, 11, 13, 16, 17, 20 and 21 under 35 U.S.C. § 103 have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of newly found prior art. See Claim Rejections under 35 U.S.C. § 103 Section above.

*Allowable Subject Matter*

13. With respect to claims 6, 12 and 18, Applicant's arguments have been fully considered. However, upon further consideration claims 6 and 12 remains objected as being dependant upon a rejected base claim. Amended claim 18 is allowed as indicated in the Allowable Subject Matter Section above.

***Conclusion***

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Matsushima disclose an Image Processing Apparatus, Image Processing Method, Computer Program and Storage Medium, Fujimora et al. disclose a Video Contrast Enhancer, Kim et al. disclose an Image Enhancing Method Using Mean-

Matching Histogram Equalization and a Circuit Thereof, and Hwang disclose an Image Processing Apparatus and Method for Magnifying Dynamic Range.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jose M. Torres whose telephone number is 571-270-1356. The examiner can normally be reached on Monday thru Friday: 8:00am - 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jingge Wu can be reached on 571-272-7429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JMT
07/23/2007

JINGGE WU
SUPERVISORY PATENT EXAMINER